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The Commissioners of the Trans-Continental Railway

GENERAL INSTRUCTIONS

From the Chief Engineer to the Staff,
Explorations and Preliminary Surveys,
Location and Construction.

ORGANIZATION.

The organization of the Engineering Department is as follows:—

1. Chief Engineer, reporting to the Commissioners.

2. Assistant Chief Engineer, reporting to the Chief Engineer, and in his absence acting in his place.

3. District Engineer, reporting to the Chief Engineer, with jurisdiction over the parties in his District.

4. Assistant District Engineer, in charge of a number of parties, reporting to the District Engineer.

5. Division Engineers, reporting to the District Engineer, and on construction in charge of a number of residencies.

6. Engineers in charge of parties on Exploration, Preliminary and Location Surveys, reporting to Assistant District and District Engineer.

7. Resident Engineer, in charge of a residency on construction, reporting to the Division or District Engineer.

8. Engineers entrusted with special duties, such as buildings, water service, bridges, etc., reporting to the District Engineer or Chief Engineer as may be instructed.

9. The Districts will be designated as A, B, C, D, E, F; the party will be numbered 1, 2, 3, etc., and the proper naming will give in every case the letter of the District and the number of the party.

DISTRICT ENGINEER.

Duties 10. The District Engineer is in full charge of all the parties in his District; he is responsible for the faithful execution of all instructions, general or special, which may be given from time to time, as well as for the proper maintenance of discipline in the parties. He will see that the Engineers in charge of parties are properly instructed, that they are competent men, and that they faithfully perform the duties entrusted to them; he will instruct the Commissariat Officer from time to time as to stores required and will make all requisitions for supplies so as to give ample time for purchasing and delivering same; he will certify to all accounts, pay rolls, etc., and send them in to the Chief Engineer on the first of every month; he will report to the Chief Engineer monthly, and oftener when opportunity offers, on all matters of interest affecting the work in his District.

It will be his duty to know the general character of the country through which the line is being run and to see that ample exploration is made in advance of the preliminary lines. Explorations

District Engineers will send fortnightly to the Chief Engineer, from the reports received by him from his Engineers, as called for in Section 12, a full report of all the work done in his District. Reports

On the first of every month, he will summarize to date all matters bearing upon his operations, giving progress being made, and such other matters as are of interest and value affecting the work.

He will forward to the Chief Engineer, duly approved, pay-rolls, expense accounts and bills.

He will take a blue print copy of the plans an profiles received and forward to the Chief Engineer's office the original tracings.

ASSISTANT DISTRICT ENGINEERS.

11. The Assistant District Engineer has in his charge the number of parties allotted to him by his District Engineer; he will make his headquarters as near the centre of his operations as practicable, and will at all times keep in close touch with all the parties under his direction; it will be his duty to guide and direct the Engineers in charge of parties, to see that they are competent and that the work is being efficiently done; he will visit the parties frequently and will remain with them for such lengths of time as will enable him to reach just conclusions; he will report by mail to his District Engineer on every available opportunity, but in every case on the first of every month, on the operations of the preceding month. Duties

ENGINEERS IN CHARGE OF PARTY.

Size of Party

12. The party in bush country will usually consist of a transitman, levelman, topographer, field draughtsman, rodman, two chainmen, picketman, four axemen, five packers, and a cook. The Engineers in charge will be responsible for the honesty, sobriety, industry and "competency" of the men under their charge, and they must give "personal attention" to see that transitmen, levelmen and others understand their work and are conscientious in its performance; they must give special attention to see that instruments are kept in adjustment; that all possible checks upon the accuracy of the work are used, and that note books are neatly and accurately kept; that the plans and profile are plotted up every day; that the party is well supplied with instruments, tents, stationery, provisions, and that all the tools and outfit for the proper and vigorous prosecution of of the work are on hand and in good order.

Competency

Supplies

Cooking, Etc.

They must see that their camps are neat and orderly, and that the cook uses provisions economically, and cooks the food neatly and cleanly.

Engineers in charge of survey parties will make a report fortnightly to their District Engineer, of the extent of their operations during the preceding two weeks; sending in tracings of plans and profiles, prepared in accordance with the sample sheets Plate "C" and "D".

On the first of every month he will summarize the work done to date, by filling out the blank spaces in form 21; together with any special matter of interest or information. He will send in his pay-rolls, expense accounts and all bills for service or materials in quadruplicate. He will certify to the correctness of the pay-rolls and the bills will be certified to on the following forms;—

Stamp "A"

"I hereby certify the above personal expense account to be correct and to have been incurred by me on the business of the Trans-Continental Railway."

Stamp "B"

"I certify the above goods have been received."

Stamp "C"

"I hereby certify the above board bill to be correct and to have been incurred on the business of the Commissioners of the Trans-Continental Railway, and that the prices charged are fair and just."

Stamp "D"

"I certify that the service described in the above account has been performed, and that the price charged is fair and just."

Stamp "E"

"I hereby certify that the goods mentioned in the above account have been received, and that the prices charged are fair and just."

Stamp "A"

Stamp "A" is to be used in certifying to personal expense accounts when the regular form is not available.

Stamp "B"

Stamp "B" is to be used in certifying to the receipt of supplies, etc.

Stamp "C"

Stamp "C" is to be used in certifying to board bills.

Stamp "D"

Stamp "D" is to be used in certifying to accounts for work performed, such as teaming, etc.

Stamp "E"

Stamp "E" is to be used in certifying to accounts for supplies purchased by the Engineer in charge.

Engineer in Charge Ill or Absent

13. Whenever the Engineer in charge of a party finds it necessary to leave the party, or in the event of sickness, he shall at once notify the Assistant District Engineer, who will appoint a person to temporarily take charge of such party, and in case he fails to do so, or during the interval of such appointment, the Transitman shall take charge.

TRANSITMAN—DUTIES.

Field Book Entries.

What to Note

How entered

Plotting Plan Profile.

Direction of Line.

14. The Transitman on beginning his work will first enter in his field book, the letter of the District, the number of the party, the name of the Engineer in charge, his own name and the date on which the work began; each page shall be separately dated and initialed; he shall make full note as he proceeds of the character of the country, soil, rocks, lakes, rivers, creeks, timber, gravel pits, etc., on each side of the line. All the field notes must be clearly entered in pencil on the spot; no additional notes should be entered with the original notes after the day on which the latter are written; field notes must not be inked in or altered in any way—copies may be made in ink. All plans and profiles must be plotted so that the end nearest Winnipeg shall be at the left hand of the paper and the end nearest to Moncton shall be at the right hand of the paper, regardless of the local sinuosities of the line.

Scales of Maps and Profiles.

Horizontal scale shall be 400 feet to an inch. Vertical scale shall be 20 feet to an inch. Ten miles to the sheet.

Instrumental Work.

The transit instrument is to be used on all lines, when the progress of the party will not be

Observation for Azimuth Latitude

retarded thereby; in an open country it is the quicker instrument; in thick bush on preliminary lines use the compass or pickets, taking the angles with the box sextant or by compass bearings, or both. Observe for latitude and azimuth, noting the magnetic variation of the compass—check your azimuth frequently so as to insure a close check on your traverse. Measure your deflection angles carefully, noting whether right or left check by doubling the angle; at the same time note the magnetic bearings, taking all possible checks to insure accuracy.

Survey, Tie

Tie your line to all townships and subdivision lines whenever crossed, give the station number and plus, intersection angle, distance to nearest post; when the line runs through a village, town or city, take enough measurements and angles to connect the survey with the map of the place, send a copy of such map to the Chief Engineer's Office; note carefully all property lines and locate all buildings that are near to the line.

Chaining

Test your chain with the 50 foot steel standard supplied. See that it is kept of the correct length; the chaining must be correctly done and a stake driven at the end of each hundred feet, and the number of chains from the starting point of the party marked thereon. The initial stake to be marked with the letter of the district and the number of the party.

Apex, how Marked.

At every apex a large stake shall be driven, having its proper distance and the deflection angle written thereon. The line is to be sufficiently cleared to enable levels to be taken.

Notes, how Entered The chaining will be noted regularly in the field book from the bottom of the page upward; each hundred foot stake as driven noted on a separate line; the space on each side of the column for distance being used for such note and sketches in the right and left of the line as may be necessary in order to give the fullest possible information of the country.

What to Note Note every stream and river crossed, its size, direction, depth of water, nature of bottom, flood marks, probable maximum volume, and whenever possible the depth to solid foundation; give full particulars of banks.

LEVELLERS' DUTIES.

15. The Leveller will open his book by entering on the first page thereof the letter of his District and the number of his party, the name of the Engineer in charge and his own name with date of commencement, each morning he will date his notes and sign with his initials.

Rodman He will be careful to fully instruct his rodman as to the duties of his position.

Field Notes All field notes must be clearly and distinctly made in pencil on the spot, no additional notes should be entered with the original notes after the day on which the latter are written; field notes should not be inked or changed in any way; copies of them may be made in ink and reduced levels entered in ink. Great care must be taken to preserve the original field notes from obliteration.

In making entries be particular to describe the locality, line, etc., so that any other Engineer can easily find the place and understand the whole at a glance.

Bench Marks on Preliminary

Bench marks should be regularly established about every 1,500 feet, and the elevation above datum written thereon thus, viz.: the elevation, letter of of the District, and number the party. Each bench mark must be fully described in the column of remarks. When two parties meet both shall check on the same bench mark, noting difference in elevation.

B. M.
1220.3
DISTRICT "A"
PARTY 3.

On Location

On location the bench marks should be about every 1,000 feet and always at the two ends of heavy cuttings, tunnels, deep fills, bridges, viaducts, etc.; positions should be selected so that they will not be destroyed in the clearing of the railway lands or be interfered with by the works. They should be numbered consecutively in each party and their numbers and elevations above datum distinctly and permanently marked thereon with blue paint, and on timber with a "scribe." When the line does not pass through timbered land, and other suitable objects cannot be readily found for bench marks, substantial posts must be sunk in the ground at least five feet, and be well packed to insure them against being raised by the frost.

What to Note

Note every stream and river crossed, its size, direction, level of surface of water, difference between high and low water, if practicable depth of the water and any peculiarities it may seem to possess. Note character and constituents of materials along the line for classification purposes.

Accuracy of Work

Every care must be taken to insure accuracy. Check back on B.M's. when necessary or possible; particular care will be exacted to insure accurate reductions; teach your rodman to check reductions; read your rod to hundredths at every turning point and all B. M's; on ordinary stations at intermediates on the line, to the nearest tenth; check the levels at the end of each day's work by adding back sights and foresights and ascertaining the differences; any doubtful sections must be re-levelled. Six hundred feet each way should be considered the maximum distance to read the rod.

Cross Section

Extent of Cross Section

What to Set Down

Before fixing the final location cross sections of all side hill work will be made, and before beginning work of grading cross sections at least at every 100 feet station whether in excavation or embankment, and also at a sufficient number of intermediate points, wherever a change in the ground takes place, so as to insure a perfectly accurate record of the various inequalities of the original surface. These cross sections will extend on each side of the centre line and at right angles thereto a sufficient distance to include all side ditches. The levels on these cross sections shall be taken in the same manner as those on the line, always commencing at a bench mark, using the same datum and checking on a B. M. at the end of the work. The actual rod reading and distance out right or left, as the case may be, as observed in the field shall be entered in the cross section field book, Form No. 8. The customary cross section notes according to American practice, which are the result of a calculation, will not be allowed.

Level Sections Required

In all cross sections a level should be taken over the edge of the roadbed to facilitate the computation of earthwork. In excavations in earth the width at formation will be 22 feet, in rock 20 feet, in embankments 16 feet and under, in height the formation width will be 16 feet, beyond that height the formation width of embankment will be 18 feet. The side slopes in earth will be 1½ horizontal to 1 vertical, in rock excavations the side slope will be ¼ horizontal to 1 vertical. Rock embankments 1 horizontal to 1 vertical (see Clause 5 Specifications). Hence in earth excavations, the levels should be taken 11 feet north and south of the centre line; in rock excavations 10 feet, in embankments 16 feet and under, 8 feet north and south of the centre line; over 16 feet high, 9 feet, levels should also be taken at the precise point of the slope stake and the exact horizontal distance out from the centre line recorded.

Width

Slopes

Off-take Drains

When off-take drains are required, a longitudinal section of them must be made in the same manner as for the centre line of the railway, and if necessary, cross sections also.

Plotting of Profile

All profiles will be plotted on Plate A standard transparent profile paper, 400 feet to an inch horizontal, 20 feet to an inch vertical, and must contain all the information called for by the sample sheet "Plate C." Stencils will be supplied for the purpose of saving time in lettering. That end of the line nearest Winnipeg shall be at the left hand of the paper, and the end nearest Moncton at the right hand, regardless of the local sinuosities of the line; ten miles to a sheet should be the rule.

TOPOGRAPHER'S DUTIES.

16. The Topographer will open his book by entering the letter of the District, the number of the party, the name of the Engineer in charge, his own name and the date.

Instrument He will carry an Abney or other type hand level, a fifty feet tape line, a pocket compass, a rod 5 feet long to sight from, a levelling rod graduated to tenths, and should generally have two men to assist in clearing out brush, make measurements, etc. He should always have with him the reduced levels of the stations so that all work will be on the same datum. He must determine the contour lines in even multiple of 10 feet, locating the position of the round figure contours, in general contour lines should be taken at 10 feet vertical intervals; he will carefully fix opposite the stake the true position of the contour line and will sketch in the connection between stakes; for example, assume that the reduced level at station 12 was found to be 976.2, the elevation of contour line 980 will be at 3.8 feet higher, etc. Note the distance to this point, 10 feet higher the next contour will be found, etc., etc.

What to Note He will enter in his book in pencil on the ground all the artificial features met with on the line, being particularly careful to secure intersection plus and the angle the line makes with all farm lines, township lines or other boundaries, the names of the owner and occupant of any land so crossed, proximity of buildings, cross fences, etc., being careful to tie the line to village or town surveys, township and county lines, measuring to the nearest post, marking lots, concessions, ranges, or other local subdivisions in use. All the natural features are to be sketched, as streams, shores, margins of swamps, forests, ravine ridges and bluffs, taking care to have them correctly intersect the artificial features. It is desirable to know not only the locality of a hill or slope, but also its shape, steepness and height; sketch contour lines, do not use hatchings.

How Entered in Book

The centre line of the Topographer's book is a straight line and for the purpose of the sketch, the centre line of the survey may be considered a straight line also. Slight deflections in the course of the preliminary line may be ignored in the sketch, but if a large angle occurs it is better to terminate the sketch with the course and begin again, leaving a few blank lines between the two sketches. Fix the distance from centre line stake both by levels and measurements. Each day's work must be plotted on the evening of that day.

General

The Topographer should have a knowledge of geology and should be able to name the materials he finds, such as limestone, slate, shale, granite, gneiss, trap, clay, cemented gravel, gravelly loam, etc., etc. He should also designate in order of occurence the several trees, such as pine, spruce, etc.

He should have an eye for the main essentials to enable him to only select the important things.

The width of the belt of country examined necessarily depends on the character of the country through which the line is being run. The reconnoissance line should have determined in a general way where the preliminary is to be run, which should be as near to a practicable railway line as possible; hence the width of the belt should be governed accordingly, the object being to secure such a representation of the surface of the ground as will enable the best possible line to be located on the ground under examination. It will be obvious, therefore, that when the preliminary line is made up of long straight lines with light angles and is within reasonably close distance of the grade line that less topography will be required. If on the contrary, the preliminary is made up of a series of short lines with great and small angles a wide area of topography should be taken in order that a careful study may eliminate curvature. On a side hill it is advisable to cover the whole slope; in a valley it is advisable to include the whole valley. The meandering of a river or creek should be carefully taken, boundaries of lakes, etc.

Note specially the presence of springs on side hills.

FIELD DRAUGHTSMEN.

17. The Field Draughtsman will plot up with care the plans and profiles each day as the notes are received by him. In plotting maps he will do so by latitude and departure. Show north point, giving astronomic courses of all lines,and marking on the map the magnetic variation. He will plot all contours with care, making every fifth line heavier than the others. He will mark on the lines the elevations in feet, referring to the datum by name. The left hand side of the paper will show that portion of the line nearest to Winnipeg. The same care will be taken to plot up profiles; the grade lines on profile will, however, be fixed by the Engineer in charge of the party. The map and profile must contain all the

information called for in the sample sheets, Plates C and D.

Stencil to be Used

Reports to District Engineer

To Keep Work up Tight

Use the stencils provided for title and lettering to save time. Tracings of maps to be sent to the District Engineer on the first of the month. Profiles to be prepared on tracing profile paper and sent in along with the plan of the line. The Field Draughtsman must keep his work up tight to the field work, particularly on location work. The projected location should be made by the Engineer in charge.

PRELIMINARY LINES.

First Preliminary

18. When the country along the projected route has been sufficiently explored to enable a choice to be made, preliminary lines will be run. The first preliminary will be run as rapidly as possible; use either the transit or compass or a picket line for the alignment. Do not waste time backing up; this line is to develop the country; use offsets freely where required; cover as much ground as possible; be absolutely sure of your levelling, checking with care to avoid errors. The Topographer should make wide excursions so as to secure all the information possible.

Second Preliminary

The second preliminary should be run with more care, seeking to place it as closely as possible to a reasonable line for the railway. In crooked, difficult places, it will be necessary to stake out approximately the curves required. Topography in such places must be carefully and accurately taken. Enough information should be secured to permit of a projected location on the map. Take out the quantities on this projected location and compare different lines on the basis of total cost.

Run enough preliminary lines to be absolutely sure that you have exhausted the possibilities of the country under examination.

LOCATION.

First Location

19. Once the preliminary lines are all completed and sufficient contours have been taken to enable a projected location to be worked out on the map, fit the first location to the ground shown on such projected location; run in the curves with care; in thick bush it is not necessary to run in spiral curves; cross section all side hills and rough places; take out the quantities accurately, and secure all needful information to enable an accurate estimate of cost to be made. Full and careful studies of all large bridges, viaducts, etc., should be made.

Second Location

The second location will be made by utilising all the information secured. The working profile will have on it the results of the first location, additional contours required, additional cross sections, etc. Study the line in detail station by station, paying particular attention to sections of heavy work, bridge and viaduct crossings, having due regard at all times to lines of total cost. It is advisable to change the personnel of the Engineer in revision work. A third location may be found desirable in certain cases; indeed, before considering the final location as settled, it is necessary to know that no better line is to be had in the country.

The preliminary locations do not demand that the stakes, reference hubs, etc., should be set with that degree of permanence which the final staking out requires; for obvious reasons it is preferable to wait until the right of way is cleared before such final staking out. All Bench Marks will be carefully checked, errors eliminated, curves will be staked out, all easement curves staked out, errors in chainage eliminated, etc.

Final Staking Out

DIRECTION OF LINE.

20. For the purpose of measuring and record, the line of railway will be considered as running westerly.

PLOTTING.

21. All plans and profiles will be plotted so the westerly end will be at the left hand of the paper.

CROSS SECTION PLOTTING.

22. All cross sections will be plotted so that the measurement north of the centre line will be at the right hand, those south of the centre line at the left hand.

DATUM.

23. The same general datum should be carried throughout the whole line, preferably the mean sea level. As this may be found to be impracticable, each District Engineer will be required to see that a uniform datum is adopted for the several Divisions of his District. When the levels meet at the end of the Districts the exact difference will be ascertained and noted. District B has special facilities to secure the mean sea level at Quebec, so that all other Districts may be readily reduced to the mean sea level.

REFERENCE HUBS.

24. Reference hubs should be placed at the beginning and end of each curve and on tangent at every twenty stations. In placing reference hubs, it is well to fix the point by intersection lines rather than measurement. The hubs should preferably be set at an angle of 45° with the line and at even distance of say 100 feet from the centre stake. When the line is near a river or lake or other obstruction, prohibiting the above described method, it is advisable to set off a line at right angles and two other lines making angles of 45° with the line and drive two or more hubs on each line at stated distance of 50, 75, etc., feet from the centre stake. The reference hub should be 3″ diameter and 12″ long, and should be driven level with the ground, the exact centre being marked with a nail or tack. The stake alongside should be marked with the station and plus, and such other marks as will identify the point. For example: R. H., 100′ left, Sta. 106 + 25, B. C. 4° left.

TABLE OF BENCH MARKS AND REFERENCE HUBS.

25. Table of bench marks and reference hubs describing exactly their position, and in case of the former, giving the number and elevation above the datum of the District, must be made out and copies filed in the District Engineer's office. The position, number and elevation of bench marks should also be entered on the working profile, at their proper station and plus.

CURVATURE.

26. The maximum curve on a level shall not

exceed 6° (Rad. 955′). This curve should be used sparingly and only when the topographical conditions prohibit an easier radius. At depots or stopping places curves exceeding 3° (Radiu. 1910°) should not be used. Curves less than 300 feet long are objectionable, and should not be be used. Reversed curves must not be used under any circumstance; at least 600 feet between transition curves must be had. Broken back curves must not be used. The minimum tangent between curves in the same direction shall be 600 feet clear of the transition curves.

COMPENSATION.

27. All curves will be compensated in accordance with the following rules: If at a stopping place, depot, etc., compensate 0.10′ per degree in the index of the curve; at other portions of the line compensate 0.04′ per degree in the index of the curve.

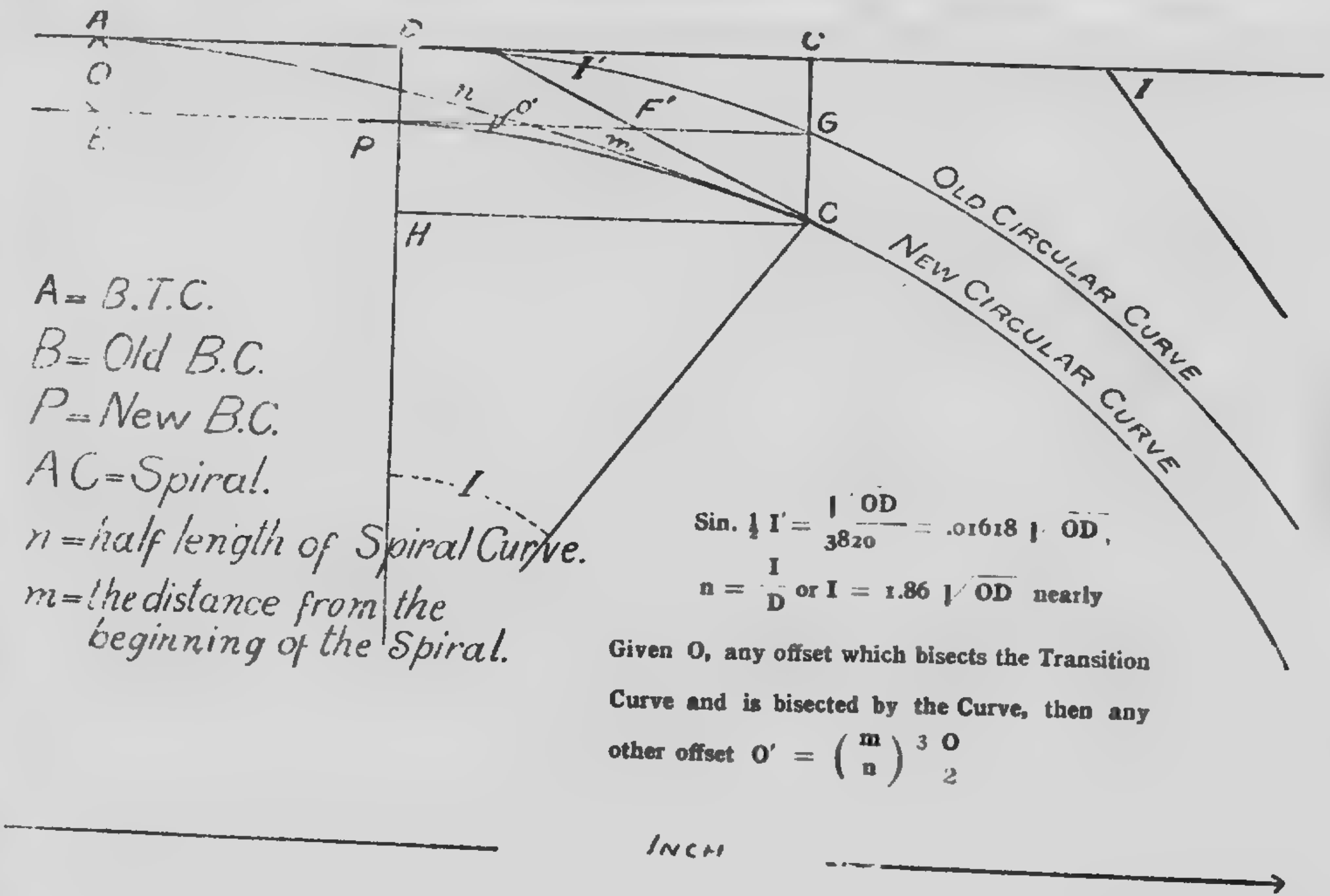
TRANSITION CURVE.

28. All curves of one degree and over will be spiralled at both ends by putting in an adjusted curve in accordance with the table and explanation which follows:

The cubic parabola as developed by the late A. M. Wellington, will be used in connecting tangents to all circular curves 1° and over. In staking out the transition curve, you will follow the rules below.

(a) Calculate for an ordinary circular curve as usual and run the tangents to the "B.C." and "E.C." as usual. (b) Make an offset at the "B.C." towards the centre of the curve (value of O); this is the distance the circular curve is moved inwards (note the distance within the limits of the table should be as great as possible); (note also that the length of the transition curve is a function of it), and that it should always be long enough to run out the super-elevation called for in the table (see Section) 62 (c) Calculate the distance the curve "B.C." should be moved backwards by formula Tan. ½ Intersection angle x O. (d) Run in the main circular curve as usual from the off-setted "B. C." (e) From the tangent and curve as thus run in, make the off-sets shown in the tables for the given value of "O". These are the same IN from the tangent OUT from the curve at the same distance from the "B.C." and "E.C." of the transition curve. At the old "B. C." the transition curve bisects the off-set "O" and is bisected by it. The off-sets are calculated for every 30 feet, one rail length, up to a distance of 240 feet. (f) To record the curve put in new "B. C." off-set at old "B. C." giving Station and plus as usual, "4.5 R. or 4.5 L.," as the case may be. (g) The plotting can be done as usual and the new curves drawn in parallel with the old one showing the spiral at each end thereof. (h) The description for Right of Way calls for a given width each side of the centre line. In describing land where spiral curves are used, it will be sufficient to say: Thence by a tangent bearing "N"–"W", (as the case may be,) from Station....to Station....a distance of.. feet. Thence along a curve to the right or left, as the case may be, of....degrees, a distance of... feet; thence on a course of....along a tangent from Station....to Station....a distance of.... feet, there being an off-set at the beginning and ending of the....degree curve of....feet for a transition curve to connect the circular curve and tangent. (i) The derivation of the functions of the spirals will be understood by following the explanation and diagram given below. The tables which follow obviate the necessity for any calculations, the best judgment being exercised in selecting the value of "O" and thereby fixing the length of the spiral.

DIAGRAM.



$$\text{Sin. } \tfrac{1}{2}\, I' = \frac{\sqrt{OD}}{3820} = .01618\sqrt{OD}\,,$$

$$n = \frac{I}{D} \text{ or } I = 1.86\sqrt{OD} \text{ nearly}$$

Given O, any offset which bisects the Transition Curve and is bisected by the Curve, then any other offset $O' = \left(\frac{m}{n}\right)^3 \frac{O}{2}$

Again, $N. = 1.86\sqrt{\frac{O}{D}}$, nearly.

Example for O′ at quarter points of the transition curve, $O' - (\frac{1}{2})\,{}^{3}_{2}O = 1\ 160$ where O = 10 feet, O′ = 0.625 feet. At ⅛ point of curve, quarter point of half-curve, the off-set will be ⅛ of the off-set at the quarter point) .078; at the ⅜ point (¾ point of half curve) it will be 3^{3} = 27 times this amount or 2.11 feet all for a total original off-set of ten feet opposite old "B. C."; half length of curve it will be five feet. In the Diagram, "D" is the old "B.C."; P is the new off-set "B. C." from which the circular curve is run (see rule "C" for position of point P.) The transition curve runs from A. to C. and is staked out on the ground from the off-sets given in the table.

Example; Given 120 + 42, Apex I = Δ = 32° 20′, – 6° curve. Therefore tangent of circular curve = 277 feet. "B.C." = 117 + 65 "E.C." = 123 + 03.8. The super-elevation of the outer rail for the curve will be taken at four inches, to reach this elevation smoothly requires an approximate distance of at least 240 feet. Hence half length of transition curve should be not less than 120 feet. The nearest distance in the table is 130 feet, giving an off-set O of 3 feet. The new "B.C."(Point P., Rule C.), (tan. ½ I x o) = 117 + 65–0.87 = 117 + 64.13. The new "E.C." will be 123 + 03.8 + 0.87 = 123 + 04.67. The "B.T.C." will be 116 + 34.13, the point of junction of transition curve with circular curve "P.J.C." = 118 + 94.13. The circular curve will run from this point to 121 + 74.67 where the spiral at the end of the curve starts the "E. T. C." is at Station 124 + 34.67.

The only stakes requiring attention during location are those at 117, off-set IN 0.15; 118 off-set OUT 0.49. Station 122 off-set OUT .018, 123+00 OUT 1.16; 124 IN 0.18 at the old "B.C." and "E.C." the spiral bisects the off-set, the hub will, therefore, be 1.5 feet in from the old "B. C."

TABLE.

Table of off-sets in from tangent out from curves for various values in Central off-set "O".

Off-sets in Feet.		0.5	1.0	2.0	3.0	4.0
Half Length of Transition Curve.		130′	186′	262	......	......
1° Curve.	30′	.003	.002	.001	......	......
	60′	.024	.016	.01	......	......
	90′	.082	.054	.036	......	......
	120′	0.192	.128	.085	......	......
	150′	......	0.25	0.17	......	......
	180′	......	0.43	0.29	......	......
	210′	......	......	0.51	......	......
	240′	......	......	.75	......	......
Half Length of Transition Curve.		93	130′	186	227	262
2° Curve.	30′	.008	.006	.004	.003	.002
	60′	.065	.048	.032	.026	.020
	90′	......	.164	.108	.081	.071
	120′	......	.384	.256	.192	.190
	150′	......	......	.50	.375	.33
	180′	......	......	.80	.74	.58
	210′	......	......	......	1.17	1.02
	240′	......	......	......	......	1.51

Table of off-sets in from tangent out from curves for various values of Central off-set "O".

	Offsets in Feet	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	
	Half Length of Transition Curve	74	107	152	186	214	238	262			
3° Curve	30′	.016	.01	.007	.006	.005	.004	.004			
	60′	.13	.087	.054	.048	.043	.039	.03			
	90′		.296	.185	.162	.148	.127	.10			
	120′			.51	.384	.351	.312	.26			
	150′				.75	.68	.62	.50			
	180′				1.29	1.18	1.05	.86			
	210′					1.88	1.70	1.54			
	240′							2.26			
	Half Length of Transition Curve	65	93	130	160	186	206	227	245	262	
4° Curve	30′	.02	.016	.012	.009	.008	.007	.006	.006	.005	
	60′		.13	.097	.079	.064	.06	.053	.048	.04	
	90′			.328	.263	.216	.198	.162	.163	.14	
	120′			.779	.633	.512	.487	.384	.386	.34	
	150′				1.20	1.0	.93	.86	.79	.66	
	180′					1.73	1.65	1.48	1.36	1.15	
	210′							2.34	2.15	2.05	
	240′									3.01	

Table of off-sets in from tangent out from curves for various values in central off-set "O".

	Offsets in Feet.	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0
5° Curve	Half Length of Transition Curve	58	82	117	143	166	186	203	219	234	249
	30′	.03	.02	.01	.01	.01	.01	.009	.009	.008	.007
	60′		.19	.12	.11	.08	.08	.08	.07	.07	.06
	90′			.45	.37	.31	.27	.25	0.24	.22	.20
	120′				.89	.74	.64	.61	.58	.53	.49
	150′						1.25	1.17	1.10	1.05	.99
	180′						2.26	2.04	1.93	1.83	1.70
	210′								3.0	2.82	2.70
	240′										
6° Curve	Half Length of Transition Curve	52	74	96	130	152	169	186	201	212	227
	30′	.04	.30	.03	.018	.014	.013	.012	.009	.009	.008
	60′		.26	.24	.15	.108	.10	.096	.095	.094	.08
	90′				.49	.37	.37	.32	.29	.28	.27
	120′				1.16	1.02	.89	.77	.71	.68	.64
	150′						1.70	1.50	1.41	1.35	1.29
	180′							2.65	2.46	.234	2.22
	210′										3.50
	240′										

Grades

The maximum grade rising eastwardly on a tangent will be 0.40% = 21.1 feet per mile; rising westerly the maximum grade will be 0.60% = 31.68 feet per mile. The maximum grade is to be used sparingly and only for the purpose of avoiding heavy work. The best grade to be had in the country must be secured in every case. On curves the rate of grade will be reduced in accordance with the rules for curve compensation.

LEVEL AT STATIONS.

29. Every effort will be required to secure a level track at stations and for 2,000 feet each side, particularly at terminal points, water stations, etc. Under no circumstances will a water tank or station be placed in a sag.

VERTICAL CURVES.

30. It is important that all changes in grade be made by a vertical curve of such length as will allow the longest train to pass from one rate of grade to another without the cars piling up against each other. With modern equipment, the rate should not be greater than 0.1 feet per station, and this rate should be used in sags, on summits a greater rate of change may be used, but not to exceed 0.3 feet per station.

BRIDGES.

31. The following data will be required for every important bridge:

1st. Profile of crossing on a scale of 20 feet horizontal.

10 feet vertical per inch.

(a) High water mark (extreme flood height).

(b) Low water mark.

(c) Bottom of river or stream, giving nature of same.

(d) Depth to rock, if any, nature of material, etc., the information must be carefully and fully taken. Suitable boring and sounding appliances will be provided when required for this work. A thorough survey must be made and careful records of same taken.

(e) Alignment near the bridge site and the grade on same, if any; when possible a bridge should be level.

2nd. (a) Plan of the river on scale of 100 feet to the inch, with contour lines at 10 feet; vertical intervals for a considerable distance each side of the proposed crossing, the distance to be proportionate to the importance of the bridge. Indicate nature of material composing banks, bottom, etc.; for large important bridges the traverse should run half a mile each way from the bridge site.

(a) Length of span suggested, proposed location of piers.

(b) Clearance required above high water mark.

(c) Shore protection required, if any.

3rd. Is it a navigable river, if so, what clear height is required to accommodate the traffic?

4th. Is the stream subject to freshets? Give velocity of current at high water. At low water. Is it subject to scour?

5th. What is the best way to reach the bridge site? Give nearest distance from railway station, or if only can be reached when the rails are laid on the railway.

6th. How far must sand, of quality required, be hauled?

7th. How far must stone of suitable quality be hauled:

For (a) masonry? (b) cement?

State fully kind of stone, size and position of quarry, proximity of gravel, etc.

WATER SUPPLY.

32. The importance of an abundance supply of pure soft water cannot be over-estimated. Hence, location Engineers will be particular to note available sources. Softness should be tested with soap. Scale forming material by boiling. Try to find a supply of suitable quality, that will flow by gravity to water tanks. In doubtful cases send a sample securely packed to the Chief Engineer's office.

COMPUTATION OF EARTH WORK.

33. For comparing preliminary lines table of level sections may be used; in comparing location lines, accurate computation of earth work should be made, using Crandall's tables, or plotting up cross section note and computing from same.

COMPUTING OVERHAUL.

34. Overhaul will be computed in accordance with the method shown in the sample profile Plate C, and the explanations which follow.

PLOTTING AND COMPUTING OF HAUL.

The contract provides that the limit of free haul is to be 500 feet, and that all materials shall be paid for at schedule price per cubic yard per 100 feet overhaul. See Plate "C" for diagram of overhaul—cuts being shown in red, fills in blue.

For purpose of illustrating the method, take the cutting from station 139 to 145 and + 20; the quantities in each station and summation of same right and left are as shown in the following table:

Station.	Cu. Yd.	Summation from right.	Summation from left.
139	....	0.	8696
140	272	272	8424
141	692	964	7732
142	1253	2217	6479
143	2464	4681	4015
144	2768	7449	1247
145	1229	8678	18
+20	18	8696	0

As the fill from Station 145 + 20 to the bridge must all come from the cut to the east, there is no object in plotting it otherwise than from the right to the left. Call each Division on the profile paper 100 cubic yards and plot over each Station the amounts shown opposite right and left. The curves joining the several points will cross each other and a perpendicular line from the intersection point will be centre of mass of the cut or the fill, as the case may be. Next, take a pair of dividers and set them to a distance of 500 feet on the profile scale. Find where the curves between the fill and cut are at this distance, draw a horizontal line, all below it comes within the 500 feet free haul. Next, take 600 feet in the divisers, join the points with a horizontal line; the distance between the 500 feet line and this latter line will give the number of cubic yards hauled 600 feet.

A further study of the cutting at Stations 117 to 121 plus 30, and the fill from 121 plus 30 to 130, will bring out clearly the extent of the haul, etc. In the above illustration as worked out, there still remains in the cutting, after the fill to the bridge is completed, 1,807 cubic yards, which will have to be hauled to the right, and upon inspection it will be be readily seen that it all comes within the free haul limit.

Note the required shrinkage so as to provide sufficient material to make the embankment; note the borrow required to complete the embankment; also, if any waste, the disposition of same. Classification can also be noted on this diagram.

Show by arrows the direction the material was moved, and the name of the contractor, the date he began and completed his work, etc.

WATER POWER.

35. Locating Engineers will take pains to secure all information possible as to the water powers along the line of the railway or within reasonable distance thereof.

The data required to be the flow of the river, in cubic cubic feet per second, the time of the year, the stage of the river, whether normal or otherwise; the head in feet, nature of bottom and banks, kind of dam required, with height of same; nature of river bottom; in general, such information as will enable an intelligent estimate to be made of the value of the power and the cost of developing it.

PEAT BEDS.

36. The presence of large peat beds along the line is to be noted; give the approximate area and

depth, send in to the Chief Engineer's office samples of material.

GRAVEL PITS AND QUARRIES.

37. Particular attention is requested to the securing of good gravel pits and quarries, from time to time report on the quantity and quality of the material found along the line of the survey.

EQUATING VALUES.

38. Tables will be supplied from the office of the Chief Engineer giving equating values, viz.: Value of degree of curvature, foot of distance (for minor savings in length), foot of rise and fall, train mile cost, cost of pusher grade, locomotive to use for calculations, etc. Price to apply to units, etc.

DISCHARGE TICKET.

39. All men in the service of the Commission have signed contracts for definite periods of employment, subject to satisfactory service. In discharging a man, always give him a discharge ticket, Form No. 7, which is printed in triplicate. Be careful to fill out the reason for such discharge and to make everything clear and plain.

TRANSFER OF MEN.

40. Should it be necessary to transfer a man from one party to another, he should be given a discharge ticket for the time due him. As reason for discharge enter transferred to party No.. . . . On reaching the party to which the person is transferred, the Engineer in charge will allow him time for travelling by the shortest and quickest route and his reasonable travelling expenses while enroute.

RECEIPTS TO BE TAKEN.

41. Receipts in triplicate for all expenditure must be taken from the person to whom the money is paid.

ACCOUNTS TO BE CERTIFIED.

42. Whenever a service is rendered or materials are supplied to any party, the Engineer in charge of such party will secure accounts in triplicate from the person supplying such materials or rendering the service, and will stamp the accounts in triplicate with the proper stamp supplied for the purpose, and will promptly certify to the same and send them in with his monthly report to the District Engineer, who will approve same and forward to the Chief Engineer for approval.

PAY ROLLS.

43. All pay rolls are to be made out in triplicate on the first of every month, making up against anyparticular person the deduction, if any and showing the balance due. Forwarding such roll duly certified to the District Engineer, who will approve same and forward them to the Chief Engineer for his approval, and to be accompanied by the deduction sheet, Form 59.

OUTFIT.

44. Camp outfit, supplies, etc., will be supplied to each party as per following list. For all parties where the outfit, etc., cannot be moved by wagon, a list for parties in settled country, where camp may be moved by wagon or sleigh, will be supplied on application.

CAMP OUTFIT FOR 18 MEN—BUSH CAMP.

2 Baking Reflectors.
3 Bake Dishes for same.
2 Frying Pans.
Nest of 6 Cook Pails, 14 qts. to 1 gal.
6 Graniteware Meat Dishes.
2 large Tea or Coffee Pots.
2 large Dish Pans.
2 Dippers, 1 qt.
2 doz. Soup Plates, graniteware.
2 doz. large Plates, graniteware.
2 doz. Tea Basins.
2 doz. Knives, iron handled.
2 doz. Forks, iron handled.
2 doz. Soup Spoons.
2 doz. Tea Spoons.
4 large Gravy Spoons.
2 large Meat Forks.
3 Butcher Knives.
6 yards Towelling, rough,
2 doz. Common Towels.
3 Pepper Dusters.
6 Wash Basins, graniteware.
1 Grindstone, with iron handle (1½ x 12 in.).
1 doz. Chopping Axes (not over 3 lbs.).
1 doz. Axe Handles.
4 Zinc Pails.
2 Bake Kettles (14 in. to 16 in. x 4 in. high, tight lid).
1 Long Handled Shovel.
3 Boys' Axes.
2 Brush Hooks.
1 doz. Small Whetstones.
1 Meat Saw.
6 heavy Wire Pot Hooks.

1 Clock (alarm).
5 yards Oilcloth (table).
1 Drawing Knife.
1 Spokeshave.
1 Jack Plane, with extra chisel.
2 Scribes.
1 Gross 1¼-in. Screws.
200 feet ⅜-in. Cotton Rope.
3 balls Twine (coarse).
1 ¾-in. Auger.
1 1-in. Auger.
1 Screw Driver.
1 pair Wire Cutting Pliers.
1 small bundle Copper Wire (200 feet).
6 tin Candlesticks.
Fishing Tackle (trolling and pole lines).
1 Letter Book and Portable Press.
1 Hand Hammer.
1 bundle Stove Pipe Wire (45 feet).

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3 Bell Tents, 14′ diam., 3′ wall and sod-cloth, 10 oz.

1 House Tent, 10 x 16, 5′ wall and sod-cloth, 10 oz.

1 House Tent, 12 x 18, 4′ wall, and sod-cloth, 10 oz.

1 Shelter Tent, 9 x 9, 10 oz. duck.
18 Canvas covers, 6 x 8, 8 oz. duck.
3 Canvas covers, 8 x 12, 10 oz. duck.
1 Boiler Plate Cook Stove (to be selected).
5 Sheet Iron Heating Stoves.
2 Levelling Rods.
1 Stationery Box.
20 pairs Snow-Shoes (for winter work).
12 Toboggans (for winter work).

FOOD SUPPLIES PER MAN PER MONTH AND FOR PARTIES OF EIGHTEEN AND TWENTY-FOUR MEN.

ARTICLES	AMOUNT PER MAN	AMOUNT PER 18 MEN	AMOUNT PER 24 MEN
Apples (evap.)	1¾ lbs.	31 lbs.	42 lbs.
Apricots	1¼ "	22 "	30 "
Alspice	½ oz.	9 oz.	¾ "
Bacon	15 lbs	270 lbs.	360 "
Beans	8 "	145 "	195 "
Butter	4¾ "	85 "	115 "
Biscuits	6 "	110 "	145 "
Baking Powder	¼ "	4½ "	6 "
Beef (corned)	8 "	145 "	195 "
Barley	½ "	9 "	12 "
Beef (extract)	½ "	9 "	12 "
Corn Meal	1½ "	27 "	36 "
Coffee	1 "	18 "	24 "
Corn Starch	1 "	18 "	24 "
Candles	2 "	36 "	48 "
Currants	1 "	18 "	24 "
Codfish	1½ "	27 "	36 "
Cheese	1¾ "	31 "	42 "
Cream (condensed)	1½ cans = 1½ "	27 cans = 27 "	36 cans = 36 "
Corn (canned)	¾ " = ¾ "	13 cans = 13 "	18 " = 18 "
Essence (lemon)	1/9 bottle = 2/9 oz.	2 bottles = 4 oz.	3 bottl's, = 5⅓ oz.
Essence (vanilla)	1/9 " = 2/9 "	2 " = 4 "	3 " = 5⅓ "
Essence (ginger)	1/9 " = 2/9 "	2 " = 4 "	3 " = 5⅓ "
Flour	37½ lbs.	675 lbs.	900 lbs.
Ginger	½ oz.	9 oz.	¾ "
Ham	10 lbs.	180 lbs.	240 "
Hops	1/18 "	1 "	1½ "
Jam	1½ "	27 "	36 "
Lime Juice	½ pt.	9 pts.	1½ ga.
Lard	2 lbs.	36 lbs.	48 lbs.
Molasses	3 pts.	7 gals	9 gal
Milk	2 cans = 2 lbs.	36 cans = 36 lbs.	48 cans, = 48 lbs.
Matches	2/9 bxs.	4 b'xs	5⅓ bxs
Macaroni	¼ lbs.	4½ lbs.	6 lbs.
Mustard	2 oz.	2¼ "	3 "
Marmalade	½ lbs.	9 "	12 "
Nutmegs	¼ oz.	4½ oz.	6 oz.
Oatmeal	5 lbs.	90 lbs.	120 lbs.
Onions	2 "	36 "	48 "
Pork	13 "	216 "	290 "
Peas	3 "	54 "	72 "
Prunes	2 "	36 "	48 "

ARTICLES	AMOUNT PER MAN	AMOUNT PER 18 MEN	AMOUNT PER 24 MEN
Potatoes (dessicat'd)	2 lbs.	36 lbs.	48 lbs.
Pepper	1¾ oz.	2 "	2⅝ "
Pickles	¾ pt.	1¾ gal	2¼ gal
Peaches (dried)	2 lbs.	36 lbs.	48 lbs.
Rice	1¾ "	31 "	42 "
Raisins	1 "	18 "	24 "
Sugar (white)	10 "	180 "	240 "
Syrup	1 pt.	2¼ gal	3 gal
Salt	1½ lbs.	27 lbs.	36 lbs.
Soap (washing)	1½ "	27 "	36 "
Soap (toilet)	1 cake	18 c'ks	24 cks
Soda	1/16 lbs.	1⅛ lbs.	1½ lbs.
Soup (condensed)	½ "	9 "	12 "
Tea	2 "	36 "	48 "
Tomatoes	1 can = 2½ "	18 cans = 45 "	24 cans = 60 "
Tobacco (chewing)	¾ "	13 "	18 "
Tobacco (smoking)	1½ "	27 "	36 "
Tapioca	½ "	9 "	12 "
Vinegar	½ pt.	9 pts	1½ gal
Vegetables (compr'd)	½ lbs.	9 lbs.	12 lbs.
Worcester Sauce	⅛ bottle = ¼ pt.	9 bottles = 4½ pts	12 bottl's = 6 pts
Yeast	½ bx.	9 bxs	12 bxs

The following named articles may be selected by the District Engineer in quantities varying from the above list but retaining the same relative amount of meat and vegetable food as given in the list:—

Bacon, Pork, Corned Beef, Ham, Peas, Rice, Oatmeal, Cornmeal, Buckwheat Flour, Condensed Soup, assorted Jam and Marmalade.

If District Engineers find from further experience that too liberal an allowance of any article is shown on this list, they should reduce their orders accordingly and advise Headquarters. Greater proportions than shown on list should not be ordered without special authority.

Assistant Chief Engineer's Office,

Ottawa, Dec. 19th, 1905.

The Commissioners of the Transcontinental Railway

MEDICINE CHEST CONTAINING MEDICAL EQUIPMENT FOR ENGINEERS IN CHARGE OF PARTIES.

One tin box with lock, key and strap, of neat size, to contain the following:

Bandages, gauze, 2″ wide, 6 yards long, ½ doz.
Bandages, gauze, 3″ wide, 6 yards long, ½ doz.
Carbolized wool in ¼ lb. packages ....1 lb
Carbolized lint, in ¼ lb. packages........1 lb.

Housewife made of canvas and tied with a tape; the inside of the housewife to have straps to hold the following:

A. Scissors, straight, with antiseptic lock; length 5″.

B. Bistoury, curved, sharp and scalpel with plain spring.

C. Needles, surgeons, in antiseptic oil, six only.

D. Catgut, No. 0, 1 and 2, in antiseptic oil one bottle.

E. Silk, carbolized, No. 1, 2, and 3, each, one reel.

F. Pins, safety, size 1½.............one doz.
" " common..........three "

Field tourniquet, rubber tube with clasp.
Zinc ointment...... ....¼ lb. pot.
Blue ointment..................... " "

Poroplastic felt, for splints, one piece the length of the tin containing box and ten inches wide.

Surgeons rubber adhesive plaster, 7″ wide and one yard long.

Tablets, Bi-chloride of mercury, antiseptic ..25 labelled "POISON" and directions on bottle.

Aromatic spirits Ammonia, labelled with dosage 3 oz.

One tin pill box with cover, hinges and clasp, large enough to contain the following bottles, packed closely in compartments to prevent breakage. The inside cover of the pill box to have the directions for use of the remedies enclosed. These directions to be printed or type-written.

No. 1. Rheumatic pill....................100
  Sodium Solicylat ....gr. 7½
  Vinum Colchi. min.................V
  Sodium Bicarbonate..........gr. 2½
  Oil of Wintergreen...............Q. S.
No. II. Pill, lead and opium, for diarrhoea .100
  Acetate of lead....................gr. 2
  Powdered opium...............gr. ⅓
No. III. Pill. sulphate of quinine...gr. 5..100
No. IV. Pill, strychnia sulph....gr. 1/60..100
No. V. Pill, morphia sulph........gr. ¼..100
No. VI. Cough Tablets...........................200
  Ammon. carb...................gr. 1
  Pulv. squills....................gr. ¼
  Pulv. senegae ....gr. ¼
  Tinct. camph. Co..................M. V.
  Terpin. hydrate.................gr. 1
No. VII. Cathartic No. 1.......................100
  Pil. Cath. Co.
No. VIII. Cathartic No. 2...............100
  Calomel.........................gr. 2½
  Sodii bicarb..................gr. 2½
No. IX. Antifebrile tablet.................100
  Phenacetine... ....gr. V
  Caffeine at.....................gr. II

Antiseptic powder (Jeys) with plain tin shaker	oz. I.
Perry Davis' Pain Killer	½ doz.
Minard's Liniment	½ doz.
Carbolic Acid Ointment	¼ lb. box

Directions for use of medicines in pill box to be pasted on inside of tin cover also on a loose card in inside of box.

RHEUMATISM. Pain and swelling of joints with fever.

> Use one pill of No. I. every three or four hours. Keep warm. Wrap inflamed joint in wool. Bowels well moved by two pills of No. VIII.

DIARRHOEA. Take one or two pills of No. VII or VIII in four hours afterwards take one pill of No. II and repeat in four hours if diarrhoea persists.

CONSTIPATION. One or two pills of No. VII or VIII at night.

COUGH. One pill No. VI every three hours.

FEVER. One pill No. IX every four hours.

PAIN. One pill No. V. every four or six hours–not over four pills in twenty-four hours.

FAINTING and SUNSTROKE. Revive with ammonia. Give one pill No. IV. every three hours. If fever use No. IX.

DRESSING WOUNDS. Dissolve one-half of one antiseptic tablet in water, bathe wound, dust in antiseptic powder and apply lint and bandage.

TO STOP HEMORRHAGE. Wind tourniquet around limb above the joint higher up than the wound.

FOR LICE. Wash well with soap and water. Cover surfaces with blue ointment and change underclothes.

FRACTURES. Soak felt in hot water. Then cut to fit the limb.

Office of the Assistant Chief Engineer.
December 22nd, 1905.

The Commissioners of the Transcontinental Railway

CONTENTS OF CACHE KEEPERS CASE

One Pill Box containing:-

No. I. Rheumatic pill	100
Sodium Solicylat	gr. 7½
Vinum Colchi, min.	V
Sodium Bicarbonate	gr. 2½
Oil of Wintergreen	Q. S.
No. II. Pill, lead and opium, for diarrhoea,	100
Acetate of lead	gr. 2
Powdered opium	gr. ⅓
No. III. Pill, sulphate of quinine...gr. 5	100
No. IV. Pill, strychnia sulph....gr. 1/60	100
No. V. Pill, morphia sulph.......gr. ¼	100
No. VI. Cough Tablets	200
Ammon. carb.	gr. 1
Pulv. squills	gr. ¼
Pulv. senegae	gr. ¼
Tinct. Camph. Co.	M. V.
Terpin. hydrate	gr. 1
No. VII. Cathartic No. 1	100
Pil. Cath. Co.	
No. VIII. Cathartic No. 2	100
Calomel	gr. 2½
Sodii bicarb.	gr. 2½
No. IX. Antifebrile tablet	100
Phenacetine	gr. 5
Caffeine At	gr. 2
Absorbent cotton	½ oz.
Bandages, gauze, 3" wide, 6 yards long	¼ doz.
Lint, absorbent	1 oz.
Adhesive Plaster	1 yd.
Carbolic Acid Ointment	2 oz.

Office of the Assistant Chief Engineer,
December 22nd, 1905.

CONTENTS OF STATIONERY BOX

3 quires Foolscap.
2 doz. Pen Nibs (assorted.)
3 pads Letter Head Paper.
6 Penholders.
30 large Envelopes.
12 Pay-Roll Forms.
100 small Envelopes.
1 Requisition Book.
6 Scribbling Pads.
1 Diary, 1906.
4 HHHH Pencils.
1 Canadian Almanac.
12 HH Pencils.
12 Transit Books.
12 HB Pencils.
6 Level Books.
150 feet Tracing Profile Paper.
150 feet Tracing Paper.
10 yards Tracing Cloth.
30 feet Drawing Paper.
24 Thumb Tacks.
1 Stencil for rods.
½-pint mixed Carmine Red Paint.
1 pint White Paint.
1 pint Black Paint.
2 Account Books.
2 sticks India Ink, good quality, water colors (red and blue).
1 box Hub Tacks.
12 copies of Form 12.
1 sheet Blotting Paper.
2 lbs. Red Keel.
6 blue Oil Chalks.
1 set Contract Forms.
24 Paper Fasteners.
1 package Pins.
3 Ink and Pencil Erasers.

3 Soft Rubber Erasers.
9 Rubber Tops for Pencils.
2 Aneroid Barometers.
1 Hand Level.
1 Compass.
2 set Squares.
1 Protractor.
1 Steel Straight Edge, 30″.
2 sets Rod Papers.
½-pint LePage's Glue.
1 pint bottle Sizing.
1 pint bottle Varnish.
1 100′ Brazed Link Chain.
3 Spare Links.
2 50′ Chesterman Tapes, reading to 10ths.
3 Brushes for Paint, small and stencil use.

CONSTRUCTION.

45. Ten to twelve miles will usually be allotted to each Resident Engineer.

It will be the duty of the Resident Engineer immediately on reaching his residency to study carefully the specifications, contract and plans, so as to be prepared to decide promptly all questions that may arise within the scope of his authority, and in order to insure this end, he will confer with his District Engineer on all points that seem to him to require explanation. He will inform himself fully of all the rules and matter contained in these instructions, and conform his work thereto in every particular. He will do all the instrumental work required on his residency in order that the contractor may rapidly and satisfactorily carry on the work in accordance with the plans, specifications and contract. He will make up monthly and final estimates of all work done in his r dency in accordance with Form Nos. 4 and 5.

He will treat contractors with courtesy a will give them all the aid necessary to exped the work, and see that the conditions called f in the plans, specifications and contract are com plied with.

RESIDENT ENGINEER REPORTS.

46. The Resident Engineer will report to th Division Engineer, if there is one, otherwise t the District Engineer.

SUPPLIES.

47. The Resident Engineer will by requisition through his immediate superior, obtain the following supplies; and in future requisitions, maintain such list at all times while the work is under way

2 pads Letter Heads.
12 No. 303 Pens.
6 No. 170 Pens.
24 Assorted Pens.
1 bottle Water-Proof (Higgins' Chin-Chin) Ink, black.
1 paper Pins.
50 large Envelopes.
100 small Envelopes.
1 bottle Writing Fluid.
1 bottle Copying Fluid.
1 stick Japanese Ink.
1 box Assorted Rubber Bands.
1 bottle Water-Proof (Higgins' Chin-Chin) Ink, blue.
1 bottle Water-Proof (Higgins' Chin-Chin) Ink, red.

Windsor & Newton's Water Colors—
    1 cake Blue.

1 cake Carmine.
1 cake Cobalt Blue.
1 cake Vermillion.
1 cake Chrome Yellow.
1 cake Venetian Red.
1 cake White.
1 cake Olive Green.
1 cake VanDyke Brown.
1 cake Chrome Orange.
1 cake Paynes' Gray.
1 cake Scarlet Lake.
1 cake Burnt Sienna.
1 box Paper Clips.
1 copy Instructions.
1 Levelling Rod.
2 Pickets.
2 3½-lb. Axes, with handles.
5 lbs. Red Keel.
6 Blue Oil Crayons.
1 pot, ½-pint, Red Paint, with brush.
1 copy Specification Contract.
5 yds. Plate A Profile Paper.
5 yds. Plate A Tracing Profile Paper.
5 yds. Tracing Cloth.
5 yds. Cross Section Paper, 10ths.
5 yds. Tracing Paper.
5 yds. Duplex Manilla Paper.
1 100′ Roe Aluminum Plated Steel Band Chain.
2 50′ Chesterman Metallic Tapes, with 2 extra Fillers, divided feet and 10ths.
3 Sheets Blotting Paper.
2 Transit Books.
1 large Cross Section Book, office record.
6 3H Pencils.
3 Penholders.

12 Pay Rolls.
1 Portable Roll Copying Press.
1 lb. Tinned Tacks.
4 Level Books.
2 Cross Section Books.
3 6H Lead Pencils.
6 No. 3 Pencils.
24 Estimate Sheets.
12 Scratch Pads.

SIZE OF PARTY.

48. Resident Engineer will be allowed a rodman, tapeman and one extra axeman. If more help is required, owing to heavy work, he will ask the District Engineer to supply same.

NOTICES TO BE SENT.

49. The Resident Engineer on his arrival at his residency will promptly notify his Division and District Engineer and the Chief Engineer, stating his post office, telegraph and telephone address.

WORKING PROFILE.

50. The Resident Engineer will obtain from the District Engineer data from the location profile to make up a working profile on Plate A profile paper, similar in every way to the sample working profile herewith. This working profile will show in pencil the approximate quantities and contemplated overhaul.

BOOKS REQUIRED.

51. The Resident Engineer will keep a transit book, level book, field and office cross section book, Form No. 8, bridge book, pile recorder's book, memorandum book, and office diary.

On the fly leaf of each book write the title, give the number of the residency, the letter of the District, name of the Engineer in charge and address thus:

"Bridge Book."

"Residency No. 6, District A."

"John Jones, Resident Engineer."

"Grand Falls, N. B."

Do not mark the cover, number the pages, date your entries, index your book, be sure and enter in the book all original measurements, do not transcribe notes from other sources, only original notes should appear. In the Transit Book should be entered all notes, reference hubs, land and other lines, etc., so as to have a complete record of the alignment and land boundaries, names of owners, occupants, etc. In the Level Book all centre line levels will be entered up, bench marks, etc.

In the Cross Section Book, Form No. 8, all original entries of all cross sections will be entered. All original notes must be set down in the book in the field. The customary way of entering cross section notes usually followed in American practice wherein the original observations are not entered, but instead the cut or fill, will not be allowed. Make your entries continuously, leaving enough blank pages to summarize everything in its proper place. Index each Section Station by Station, keeping the quantities in each mile separate. Never erase a line, if an error has been made draw lines across it and write the words "Cancelled erroneous"; if notes are continued on a succeeding page refer to it and on that page write the words "forward from page."

LENGTH OF SECTION.

52. Sections will usually be one mile in length. Give the name of the contractor on each section, note the beginning and ending stations of their work, with dates of such beginning and ending of work. Plot all the excavations on cross section paper, 10 feet to one inch; each day's cross section work to be plotted, and the quantities computed the same day the measurements are taken, with the area of the section inked in. On this plotted section as the excavation is made note accurately the character and classification of the materials found in the cut. See sample sheet Plate E; the cross section book should also contain the monthly estimate of grading, with the volume excavated each month. The cross section sheet should be colored with the proper color for the month showing the area excavated. So in like manner the progress profile should have the volume colored with the appropriate color.

BRIDGE BOOK.

53. In the standard bridge book the notes of bridges, culverts and other structures, as well as drainage and other special matter, should be entered. On the left hand page, all bills of timber, piling and quantities should be entered, and on the right hand page a sketch of the structure, showing a ravine section; full notes of pile driving as per form below shall be taken,also kind of material penetrated; in case of masonry or concrete culverts or other structures, sufficient dimensions must be shown to enable the quantities to be

calculated ; describe fully and carefully the exact kind of material the structure is founded upon. Give the quantities, classification and disposition of the excavated material. Particular care is required to insure absolutely safe foundations. No chance will be taken; in case of doubt consult the District Engineer. Under each structure enter the name of the contractor and the foreman in charge of the work, the date in which work started and ended. This Bridge Book, properly filled up, will be returned to the District Engineer as a final estimate on the completion of the works therein entered.

PILE AND TRESTLE BRIDGES.

54. In the construction of pile and trestle bridges, a competent Inspector will be supplied, whose duty it will be to watch the driving of piles at all times and to keep a record of all piles driven. The Inspector shall require piles to be driven such depth as will make them secure against being washed out by scour, and in accordance with the clause of the specifications relative to pile-driving. See Section of Specifications 145.

The record of all pile and trestle bridges shall be kept in a book ruled and headed as per sample herewith. For convenience in designating any particular stick of timber, he will call the first bent nearest to Moncton, Panel A; the second bent and span, Panel B, etc. Piles, posts, stringers, guard rails, will be numbered from left to right (i. e., south to north) and the bridge ties will be numbered in the same direction as the letters of the panels. The position of the bridge will be designated by the station and plus of its beginning and end—and the number of the same. In accordance with the above plan, it is easy to understand the location of a timber, as pile B3—Stringer A3 or bridge tie 38, as the case may be. The record kept by the Inspector must show the depth to which each pile is driven, the depth by the last five blows of the hammer and the depth by the last blow. The form of this record to be as below.

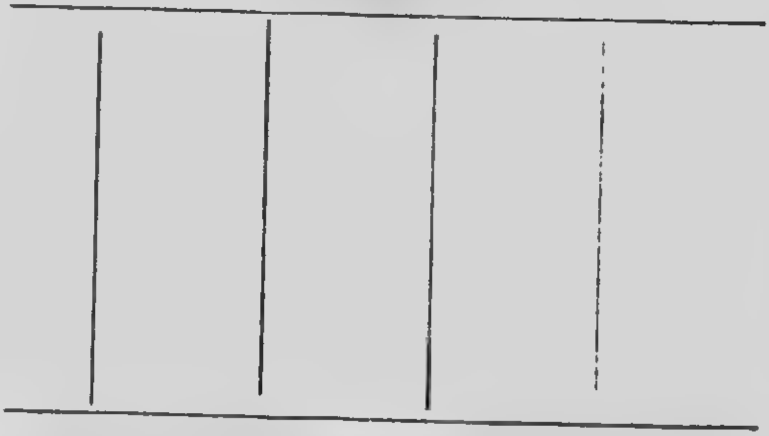
Bridge No. 10 { Weight of hammer, 3,000 lbs.
Stations 160 + 60 { Steam hoist, quick actions, or as the case may be.

PANEL A.

Pile Wing.	Deep.	Last 5 Blows.	Last. 3 Blows.	Fall of Hammer.
1	8 ft.	2 ft.	3 in.	28 ft.
2	9 ft.	2½ ft.	5 in.	28 ft.
1	14 ft.	1 ft. 3 in.	½ in.	30 ft.
2	14½ ft.	2 ft. 0 in.	1½ in.	29 ft.
3	13 ft.	1 ft. 6 in.	1 in.	30 ft.
4	15 ft.	2 ft. 0 in.	2 in.	30 ft.

PANEL B.

PANEL C.



REMARKS.

The soil at this bridge is sandy at a depth of about 13 feet, below grade the piles strike a hard stratum of material with which piles cannot be driven more than 2 or 3 feet.

I had the depth to hard material also tested with water jet.

55. This record book of the Inspector will be turned over to the Bridge Engineer, who will then make up a complete record for each bridge in form as shown below, in which (a) represents the height of pile from the surface of the ground to the top of cap timber, and (b) represents the length of the pile below the surface of the ground. Following the record of the piles there must be a complete bill of piles and other material used in the construction of the bridge, and a memorandum of any facts of interest or importance connected with the situation of the bridge or its surroundings. In this record and in their proper place, all timber culverts and cattle guards must be entered, with description, dimensions and bill of material; also, all truss bridges, with location, description, and dimensions and bill of material in the floor system.

Bridge No. 10. Station 160 + 60.

PILE.

Panel.	1	2	3	4
A	a = 6½ ft. b—14′	a = 7′ b—14½	a = 3½′ b—13′	a = 9′ b—15′
B				
Wing Pile				

BILL OF PILES USED.

159	16
	78
	20
	40

REMARKS.

This is a pile bridge. The piles are driven in sandy soil, striking a stratum of hard pan at a depth of 20 feet, below the Cap timber.

BILL OF MATERIAL.

	Pcs.	Size.
Stringers		8″ x 16″ x 26′
Caps		12″ x 12″ x 14′
Guard Rails		8″ x 9″ x 16′
Sway Braces		3″ x 10″ x 20′
Retaining plank		– 600′ B.M.
Packing bolts.		
G. R. Braces		
Drift Bolts		
Spools		
Washers		

FORCE RETURNS.

56. The Resident Engineer will secure force returns from the contractor once a week; this return shall be taken personally by some person in the employment of the Commissioners, and must be verified with the contractor's time book.

It will show the number of men employed each day, the number of teams, hoisting engines, derricks, etc., all classified as called for in Form 54.

Under remarks note any special information. At the end of each month summarize the force returns giving daily average and total days' work, average wages paid for men and teams, all the information called for in Form No. 55. Send one copy to the District Engineer's office and one copy to the Chief Engineer, Ottawa, Ontario.

Under remarks briefly state the progress of the work in each mile, the location of pile driver, steam shovel, etc., and station at end of track, etc.

MONTHLY PAY ROLLS.

57. On the first day of every month all pay rolls are to be made out, with deductions, if any, in triplicate, on Form No. 143.

Personal expense statements are to be made out on Form No. 22, in triplicate. Expense Account

All bills are to be rendered in triplicate, to which certificate of receipt of the goods or service, as the case may be, shall be attached. Bill

Approximate monthly estimates in triplicate will be prepared on Form Nos. 4 and 5. Estimate

Progress profile will be made up in accordance with sample sheet. Progress Profile

All to be certified to and be signed by the Engineer in charge and forwarded by first mail to the District Engineer who will approve same and forward to the Chief Engineer.

CHECK ALIGNMENT.

58. The Resident Engineer on taking charge of his residency will as quickly as possible check all curves, spirals, tangents, run check levels over the residency, reporting at once to the District Engineer any errors found. He will reference all B. C., E. C. or other points, B. M's, etc.

LOCATION STATIONS TO BE PRESERVED.

59. The final location stations are to be maintained throughout the work, and all records must conform to them. Should errors or discrepancies be found note the amount, long or short, giving its correct length, but preserve the station number. The track chaining must also agree with the location stations.

MILE POSTS.

60. The station for each mile post will be given the Resident Engineer, and the beginning and ending of mile thus shown must be maintained throughout the work in all records. All material excavated from cuts, borrow pits, ditches, etc., must be estimated on the mile where such material was excavated. The cost of every item of work on each mile must be kept separate, so that if material is hauled from one mile to another it must be so designated in the book, showing such mileage cost. In case a borrow pit is opened on one mile and the material goes to another, such excavation will be charged against the mile where the earth is placed in the embankment.

PROGRESS PROFILE—HOW COLORED.

61. A progress profile is to be used as a monthly progress report of work done, and will be prepared

on Plate A profile paper, in every respect similar to the sample sheet Plate E, and will be forwarded as stated in Section 58. It will be returned to the Resident Engineer each month in time for him to post up for the month. Show in colors for the given month, as below, the excavations moved and embankment placed. Show the index of these colors under the title in the profile. For January, Cobalt blue; February, vermillion; March, chrome yellow; April, Venetian red; May, white; June, olive green; July, Vandyke brown; August, Antwerp blue; September, chrome yellow; October, Payne's grey; November, scarlet lake; December, burnt Sienna.

Show on the profile the direction the excavation is being hauled by arrows and by plotted haul. Note above each structure in ink, the date work started and ended, at what bridge the pile driver is working, end of track, etc.; give the contractor's name, and such other data as will plainly indicate the progress of the work.

SUPER-ELEVATION OF OUTER RAIL ON CURVES.

62. As all curves 1° and over will have their ends eased off with transition spiral curves, the tangents will be level. The super-elevation will be put in on the spiral gradually increasing with the increased radius of the spiral, the whole amount of the super-elevation called for in the table below to be put in on the circular portion of the curve:

TABLE OF THE SUPER-ELEVATIONS OF THE OUTER RAIL ON CURVES.

Degree of Curve.	Amount of Super-Elevation of Outer Rail.	Distance to Run Out.
0° — 30′	¾″	45 feet
1° — 00′	1,†	60 "
1° — 30′	1 ¼″	75 "
2° — 00′	1 ½″	90 "
2° — 30′	1 ⅞″	112½ "
3° — 00′	2 ¼″	135 "
3° — 30′	2 ⅝″	157½ "
4° .. 00′	3, ″	180 "
4° — 30′	3 ⅜″	202½ "
5° — 00′	3¾″	225 "
5° — 30′	4 ⅛″	247½ "
6° — 00′	4½″	270 "

STAKING OUT WORK.

63. As soon as possible the cross sections should be finished up. Plot each cross section and calculate its area the same day. All work must be staked out, ditches, creek diversions, right of way, berms, etc.; set stakes for all excavations and embankments to sub-grade, as shown on the grade line of the profile. Stake out bridge ends as shown on masonry plans, etc. Use good strong stakes, well driven; mark the proper station and plus on the side from the roadbed and the cut or fill on the back; mark the center stake likewise. Cross section curves at least every fifty feet, unless the surface is practically level.]

DITCHES.

64. Catchwater or surface ditches shall be staked out and be excavated at the same time as the cuts are opened; they should be neatly cut, placing the material in the embankment if required to make the fill, otherwise on the lower side in a uniform manner. Ditches should not be less than eighteen (18") inches deep and two (2') feet wide at the bottom, with side slope of 1½ horizontal to 1 vertical, and should be at least ten feet away from the edge of a cut. Secure a good grade to allow the water to run away freely. Keep the outlet away from the toe of the embankment so as not to endanger same. All ditches must be left clean by the contractors.

DANGEROUS TREES.

65. The Resident Engineer will specially mark all leaning trees that are liable to fall across the telegraph line, or that may fall across the right of way, standing outside thereof, and will see that they are cut down and removed as called for in the specifications, Clause 7.

LARGE BLASTS.

66. Under Clause 13 of the specifications, large blasts are restricted. On side hill work the tendency of such large blasts is to throw material to waste. If it is required in an adjoining bank, the contractor must supply free of cost for every cubic yard so wasted one and one-half cubic yards of other suitable material for the bank.

PUBLIC AND FARM ROADS.

67. The Resident Engineer shall take particular care to insure that, at all public and farm

road crossings at all times, a safe crossing is in good order; that the contractor takes all reasonable precaution to protect the public from injury due to his operations, and will hold the contractor to a strict account in this particular matter.

CLEARING.

68. The specifications must be closely observed; dead or leaning trees within the limits called for in the specifications must be cut down and removed, the right of way must be left clear. Great care must be taken in burning brush to see that all the Provincial Fire Regulations are observed, and every precaution must be insisted upon to insure the protection of the forest from fires.

Fire in Bush

GRUBBING.

69. See that all grubbing is burned up and that the specifications are strictly adhered to. Grubbing will not be estimated in cuttings over four feet in depth (see Clause 11 of specifications).

CENTRES.

70. Resident Engineer will give centres in all cuttings from time to time to insure the contractor excavating to the required lines and slopes, and will see that the slopes are left clean and true. Projecting or dangerous rocks on slopes must be removed. Slides of rock loose or solid must be carefully guarded against.

**Projecting
Rocks
Slide**

BACKFILLING ROCK CUTS.

71. Backfilling in rock cuts must not be done until the required excavation one foot below

grade is finished. The material used shall be broken stone or coarse, clean gravel.

EMBANKMENTS.

72. Embankments are to be built of the full width and slope called for in the specifications. In setting out formation width, make proper allowance for subsidence as called for under Section 39 of the specifications. Embankments up to 16 feet in height will be 16 feet wide at formation level, beyond this height 18 feet wide, side slope for earth 1½ to 1, for rock 1 to 1.

BORROW PITS.

73. Borrow pits will be staked out when and where required; they must be left clean and neat with slopes of 1½ horizontal to 1 vertical, and must not be excavated closer to right of way lines than three feet and not closer to the toe of embankments than the distance called for under Section 30 of the specifications. Where possible they should always be left so that they will drain through the nearest opening.

FINISHING STAKES.

74. Resident Engineers will set accurately, squared strong stakes at each station, marking the toe of the embankment, the edge of the cutting, the edge of the embankment, correct as to finished levels and line, and will see that the embankments are graded so that when full settlement takes place they will conform to such stakes, and that the cuttings are excavated cleanly and neatly to the full lines.

STATION GROUNDS.

75. Resident Engineers will secure plans of station grounds and will not allow any borrowing to be done within the limits of the site. Tracks and buildings, drains, etc., will be accurately located and staked as shown on the plan.

TRACK CENTRES.

76. Track centres will be accurately set. Stations on tangents to be every 100 feet, on curves every 50 feet. Mark the beginning of the adjusted curves centres at 30 feet intervals on same, also the ending of the spiral; rails must be laid with broken joints; in passing around curves shorter rails will be provided in order that the centre of one joint shall, as near as may, be opposite the centre of the opposite rail. Rails should not be cut. Track must be fully spiked as it is laid and the spikes must be set vertical, and driven home so closely as to hold the rail firmly to the tie, but not so hard as to break the head of the spike. The track must be gauged as spikes are driven at "joints", "centres", and "quarters", and no excuse will be taken for inaccurate gauging. On straight lines track will be gauged to 4 feet 8½ inches. On curves, in accordance with the following, viz.:

1°, curve = 4 ft. 8⅝ in,; 2°, 4 ft. 8⅝ in,; 3°, 4 ft. 8¾ in.; 4°, 4 ft. 8¾ in.; 5°, 4 ft. 8¾ in.; 6° 4 ft, 8⅞ in.; 7°, 4 ft. 8⅞ in.; 8°, 4 ft. 8⅞ in.; 9°, 4 ft. 9 in.; 10°, 4 ft. 9 in.

The joints must be firmly secured in place by the full number of bolts well drawn up, and special attention should be paid to the adjustment of any nut lock device which may be used.

Ballast grades will be set and the top of the rails must conform to the level called for by them. Particular care is demanded in packing the ties; the tamping must be thorough, the tie thoroughly supported throughout, the space between the ties packed full and the shoulder at the end of the tie as called for in specifications, and cross sections of same. The slopes to be neatly and exactly laid to that called for. Particular care will be taken to set the ballast grade stakes on curves to give the proper super-elevation called for, the inner rail being kept to the true grade. On spiral curves the super-elevation will be gradual and proportionate to that on the circular curve, the tangents being level. **Ballast Grades**

SWITCHES.

77. Special attention should be given to the laying out of switches, turnouts and frogs. The frogs, of angles of 6° 22′ and those of 9° known as number 9 and number 6½, only will be used.

All turnout curves are considered as beginning at the fixed end of the slide rail, and all Engineers must make their calculations for determining the position of head-block and point of frog on this basis. Sidings at different distances from the main track will be located, in the absence of special instructions, according to the following table, the turnouts being from straight lines.

TABLE SHOWING ALIGNMENT OF SIDINGS.

Distance from Siding to Main Track, Centre to Centre	Turnout Curve		Length of Tangent.	Curve Returning Parallel with Main Track.	
	Degree.	Length.		Degree.	Length.
12 ft.	7°, 30′	95.8 ft.	......	7° 30′	95.8 ft.
13 ft.	7°, 30′	99.7 ft.	......	7° 30′	99.7 ft.
14 ft.	7°, 30′	103.4 ft.	......	7° 30′	103.4 ft.
15 ft.	7°, 30′	107.1 ft.	......	7° 30′	107.1 ft.
16 ft.	7°, 30′	110.7 ft.	......	7° 30′	110.7 ft.
17 ft.	7°, 30′	114.1 ft.	......	7° 30′	114.1 ft.
18 ft.	7°, 30′	117.4 ft.	......	7° 30′	117.4 ft.
19 ft.	7°, 30′	120.0 ft.	1.13 ft.	7° 30′	120.0 ft.
20 ft.	7°, 30′	120.0 ft.	7.52 ft.	7° 30′	120.0 ft.
22 ft.	7°, 30′	120.0 ft.	20.31 ft.	7° 30′	120.0 ft.
24 ft.	7°, 30′	120.0 ft.	33.09 ft.	7° 30′	120.0 ft.
26 ft.	7°, 30′	120.0 ft.	45.88 ft.	7° 30′	120.0 ft.
28 ft.	7°, 30′	120.0 ft.	58.66 ft.	7° 30′	120.0 ft.
30 ft.	7°, 30′	120.0 ft.	71.45 ft.	7° 30′	120.0 ft.
40 ft.	7°, 30′	120.0 ft.	135.38 ft.	7° 30′	120.0 ft.
50 ft.	7°, 30′	120.0 ft.	199.30 ft.	7° 30′	120.0 ft.
60 ft.	7°, 30′	120.0 ft.	263.23 ft.	7° 30′	120.0 ft.

The ends of switch ties must be laid off to a line parallel with the nearest rail. Guard rails opposite frogs shall be cut twelve feet long and bent to a standard pattern upon formers. The gauge of track of all turnout leads shall be 4′, 8⅞″, and this width must extend from the fixed end of the slide rails to the heel of the frog.

BUILDINGS.

78. The location of all buildings will be decided in the office of the Chief Engineer, and the Bridge and Building Engineer will receive instructions in regard to location. Special care must be taken in the laying out and construction of foundations, and a full record must be kept of the dimensions of all masonry built. The following rules will govern the location of all buildings and platforms, as to their distance from tracks, viz.: The tops of all platforms adjacent to the main track should be 12 inches above the top of the rail (conforming to the grade of the track) and the nearest edge of the platform 2 feet 9 inches from the gauge side of the rail. The tops of all freight platforms on side tracks for general use should be 3 feet 8 inches above the top of rail on side track (conforming to grade of track), and the edge of platform 3 feet 3 inches from the gauge side of the nearest rail. No building should be located nearer than 7 feet in the clear from the centre of the main track.

No building should be nearer than 6 feet from the centre of any side track, which is used for meeting and passing trains, or for general purposes.

All buildings or other structures, erected by corporations or other parties, and all stone, ties or timber piles for Company use, should not be located nearer than 6 feet from the nearest rail.

PERMANENT STAKES.

79. Resident Engineers will plant permanent stakes at the B. C. and E. C. of every curve and at the point of commencement of spiral curves, when the track laying and ballasting is completed;

for this purpose they will requisition their District Engineer for suitable monuments.

PERMANENT BENCH MARKS.

80. Place permanent bench marks reduced to true sea-level datum.

DIARY.

81. The Resident Engineer will keep a daily record in his diary of all instructions given to contractors; he will enter the date on which work under each contractor began and ended; the date of beginning and completion of all openings and important piece of work; also notes classifying material, the manner in which the contractor handles his work and such other notes as will enable a complete accurate classification to be made; the date of any special notices or instructions served upon contractors; every item bearing upon the work should be entered daily. Record in your diary all storms, such as extraordinary high winds, heavy rainfalls, low temperatures, excessive snowfalls, etc.

LIMIT OF HAUL.

82. It must be understood that all excavation is to be hauled to the limit; no borrowing will be permitted, unless the overhaul price exceeds the earth work price. When it is necessary to waste, the material should be used to widen embankments within the limit of the free haul, waste to be uniformly and evenly distributed. No waste will be placed on the sides of cuts nor overhaul paid on waste unless first approved by the District Engineer.

The contractor should be told where the excavation is to be hauled, to avoid waste and borrow.

MONTHLY ESTIMATES.

83. The Resident Engineer will prepare on Form No. 4 approximate monthly estimates of all the work done and materials delivered on the work section by section, using a separate sheet for each section. And on Form No. 5 a summary estimate of all the work done on all the sections under one contractor. This estimate must show the total amount of work done from the beginning of the work to the end of the month for which the estimate is made, entering earth works to the nearest 100 cubic yards, timber to the nearest 1000 feet, masonry to the nearest cubic yard, etc. Fill all the blanks, or note no work done where such is the case.

The amount due for the current month should be shown in red figures.

Note in remarks column anything affecting result, such as material hauled from an adjoining mile. Should the mile post come in the centre of a structure group the two sections together, but in general each section should be shown complete by itself.

EXTRA WORK.

84. The contract provides that all claims for extra work or material must be presented to the Chief Engineer for allowance at the close of each month in which it was done, otherwise the Commissioners are not required to allow or pay for same. Resident Engineers will write to the

District Engineer for the Chief Engineer's approval for the contemplated work, noting the estimated cost. This approval will be promptly returned to the Resident Engineer and he will attach same to the contractor's bill and return both with the monthly estimate, adhering strictly to the contract that no bills will be allowed that are rendered later than the month in which the work was done. The Resident Engineer will report fully upon the proposed extra work, the reasons for same, and in general give such full information as will enable the Chief Engineer to reach a just conclusion.

CHANGES IN GRADE OR ALIGNMENT.

85. Resident Engineers will not be allowed to make changes in grades or alignment, but will promptly call their District Engineer's attention to any possible change they consider beneficial. Rates of grade fixed on the location profile will govern and must be adhered to. Vertical curves will be carefully graded to elevation called for. Easement curves will be staked as per table and according to the directions given for same.

FINAL PROFILE.

86. A final profile must be made as per sample Plate C, on a continuous roll of Plate A profile paper, 400 feet to an inch horizontal, 20 feet to an inch vertical. Leave 18 inches blank space at each end. Place a neat title at each end of the roll as shown in sample sheet. On the outside edge at both ends of the profile write "Final Profile Residency No......., District ......, Na-

tional Trans-Continental Railway, Eastern Division. Miles ...... to ...., Station ....to .... On this final profile follow the general style of Plate C. Plot overhaul as shown. Give the stations and plus of the Moncton end of stringer on pile and girders and other bridges, centre of all pipes and other culverts, plus of all roads and cattle guards, names of rivers, brooks, cities, towns, villages and stations, length of sidings with plus of switch stand, semaphores, alignment, position of water tank and stand pipe, bench marks and clearing, width of right of way, fencing for each fence, gate and farm crossings; note quality and description of ballast; summarize the entire residency mile by mile, giving totals of all classifications and quantities.

FINAL ESTIMATES.

87. Quantities for final estimates are to be made up promptly and completed as fast as the work is finished. Particular care is required to secure accurate computation, and frequent checks will be made to insure accuracy. A copy of Crandall's table will be supplied and should be used in checking quantities. All final estimates will be made up in ink, that for all grading, clearing and grubbing in the standard field cross section book and be fully entered in the office cross section book in ink, fully explaining by notes, the classification and disposition of all quantities. These notes must be full and sufficient to enable the making from them of a summary, which summary will be the original of what is to appear on the final estimate sheet.

Clearing and grubbing must be shown on a page by itself, and the station numbers given between which clearing and grubbing is estimated, with width of area, also the name of the contractor, the total being placed in the summary. The notes for all excavations quantities, not entered in the cross section book, are to be referred to by notation, giving the book and page upon which they appear, such as foundation pits or other excavations, the notes of which belong to the bridge book. A total summary must be made showing each mile on a separate line for the entire residency at the end of the book, which must be signed as correct. All cross sections must be inked in, showing fully the classification lines and the total classification for each cut.

The final estimate in detail for all bridge substructures, box and other culverts, pipe drains and other structures pertaining to the case of drainage is to be returned in the bridge book, as instructed in Section 54. Such book must show quantities, classifications and disposition of all the material handled, and the notes necessary to check the quantities, together with the name of the contractor. The estimate will be made out in triplicate, be signed as correct, and forwarded to the District Engineer, who will check same, approve and forward to the Chief Engineer.

ESTIMATES NOT TO BE GIVEN TO CONTRACTOR.

88. It must be distinctly understood that the Resident Engineer is not to give any estimates to the contractors. All such information must come direct from the Chief Engineer.

RESIDENT ENGINEER REPORTS.

89. The Resident Engineer will report fortnightly to his District Engineer, giving a concise summary of the condition of all the work in his residency.

DISTRICT ENGINEER REPORTS.

90. The District Engineer will send in to the Chief Engineer once a month, or oftener when opportunity offers, and there is matter of interest, full reports of all the work in his District.

ACCOUNTING.

Classification of Construction Expenses.

ENGINEERING.

91. To this account should be charged all salaries and expenses of Engineers, Assistants, and Axemen; teams for transportation of Engineers and men to and from work, or upon trips of inspection of line of work, or incidental thereto; Engineer's instruments, rods, chains, axes, hatchets, tape lines, keel or marking chalk, stakes, profile and drawing paper, tracing linen or paper, cross section paper, transit and level books, cross section or topographical books, India ink and colors, drawing boards, stools, map cases, paper racks, stationery for office or field, fuel, lights, and camp equipage, and other analogous items.

Proportion of Engineers' expenses when engaged on special work should be charged to same.

RIGHT-OF-WAY AND STATION GROUNDS.

92. To this account should be charged the cost of land acquired for roadbed (of necessary width conformably to depth and slopes of excavations and embankments), station and terminal grounds; also the cost of land purchased for ingress or egress to or from station grounds; salaries and expenses of counsel, right-of-way Agent, and of Engineers and assistants when especially engaged upon such matters; stakes used to denote right-of-way limits; expenses of Appraisals,

or of Juries, Commissioners or Arbitrators in condemnation cases; cost of removal of buildings when upon right-of-way, station or terminal grounds, but not included in property purchased; stationery supplied Right-of-Way Agent, Engineers, and assistants, engineers' instruments, etc., when used for such purposes; commissions paid outside parties for purchase of properties for these purposes; cost of plats, abstracts, notarial fees, recording deeds, etc.

Note particularly account No. 3, "Real Estate," as regards the cost of property purchased but not required for the operation of the road.

REAL ESTATE.

93. To this account should be charged the cost of all land purchased by the railway company in excess of that actually required for roadbed, station or terminal grounds, or other specific purpose, including all expenses incurred in connection with such purpose as enumerated in account No. 2, "Right-of-Way and Station Grounds." A portion of the cost of land purchased outside right-of-way for borrow pits or waste banks should be charged to this account.

NOTE—The amount to be charged to real estate should be an estimate of the salable value of said borrow pits or waste banks after completion of the road.

GRADING.

94. To this account should be charged the cost of grading roadbed, whether excavations or embankments; clearing and grubbing; dressing slopes of cuts and fills; reconstructing pikes or roads; ditching roadbed; berm ditches; cost of

material taken from borrow pits, haul if allowed; amounts paid for privilege of making waste banks outside of Company's right-of-way or station grounds; ditches for water ways not specially required by right-of-way agreement, in which case cost would be properly chargeable to account No. 2, "Right-of-Way and Station Grounds." This account includes retaining walls and other masonry or riprap for the protection of embankments, cuts, and slopes; cribbing or bulkheading built to protect the tracks or embankments along the seashore or banks of lakes and streams, including the cost of any cribs, breakwaters, wing dams, or other devices constructed to change the direction of the current of a stream to prevent the washing of the bank; also freight on material and transportation and subsistence of grading gangs.

TUNNELS.

95. To this account should be charged the cost of tunneling including such timber as may be used for centreing, packing, etc.; cost of stone, brick, cement, sand, lime, salt, piles, timber, spikes, nails, braces, concrete, etc., used in the construction or lining of the same; cost of labor preparing or securing the same, transportation, scaffolding, cofferdams, and pneumatic caissons; cost of soundings, and machinery, pumps, engines, etc., used for such work. This account does not include grading or surfacing the roadbed, or cost of the track through the tunnel.

BRIDGES, TRESTLES AND CULVERTS.

96. To this account should be charged the cost of all bridges and trestles erected to carry

tracks over streams, ravines, streets, or other railways, and culverts, both substructure and superstructure, including transportation. This account should include abutments, piers, supports, draw and pier protection; machinery to operate drawbridges; masonry ends and wing walls for culverts; cost of inspection of bridge material, either at shop or site of structure; cost of tests; cost of wing dams, cribs, or ice-breakers for the purpose of regulating the current of a stream or breaking up ice jams before reaching a bridge; also labor and material used in painting structure.

In case "false work" is furnished by the railway company for erection of bridge superstructure, the cost of same should be charged to this account, and when removed, the value of the material removed should be credited to this account and charged to the account benefited.

TIES.

97. To this account should be charged the cost of all cross, switch, bridge, and other ties laid in the main track or tracks, sidings, spurs, gravel, and repair tracks; in tunnels, depots, shop, and other yards, shops, and other buildings, etc.; on turntables, wharves, piers, track scales, inclines, bridges, trestles, and culverts; to and from coal chutes, coal pockets, fuel, and water stations, etc.; also the cost of transportation, inspection, loading, unloading, and any process of preservation.

RAILS.

98. To this account should be charged the cost of rails laid in the main track or tracks, sidings, spurs, gravel, and repair tracks; in tunnels,

depots, shop, and other yards, shops, and other buildings, etc.; on turntables, wharves, piers, track scales, inclines, bridges, trestles, and culverts; to and from coal chutes, coal pockets, fuel, and water stations, etc.; also the cost of transportation, inspection, loading, and unloading.

TRACK FASTENINGS.

99. To this account should be charged the cost of spikes used for laying rails, and of fish and tie plates, splice or angle bars, chairs, rail braces, bolts, nuts, nut locks or washers used in connection with same; also the cost of transportation, inspection, loading, and unloading.

FROGS AND SWITCHES.

100. To this account should be charged the cost of all frogs, switches, and switch material including switch stands (throw or lever), frog guard rails, crossing frogs, and timber, bolts, etc., used in foundations or base for same, and cost of transportation.

BALLAST.

101. To this account should be charged the cost of all ballast, whether of broken stone, slag, gravel, or other material especially provided for this purpose; also the expense of loading, hauling, unloading alongside of track, and transportation.

TRACK LAYING AND SURFACING.

102. To this account should be charged the cost of distributing, laying, spacing, and lining ties; cost of laying, spiking, and jointing rails, surfacing and lining track; including the adjustment of rail to proper elevation, and labor of placing

frogs and switches; cost of track tools, including shovels, picks, track jacks, crowbars, levers, spiking mauls, gauges, and wrenches; cost of putting in ballast; service of engines, cars, and crews distributing track material, and transportation.

FENCING RIGHT-OF-WAY.

103. To this account should be charged the cost of all material and labor used in constructing board, wire, rail, hedge, stone, or other fences along the right-of-way or limits of roadbed, and transportation; but no charge should be made to this account for fences constructed around stock yards, fuel stations, station grounds, shops, and on other properties outside of right-of-way, which should be charged to their appropriate accounts. The cost of permanent or portable fences for protection of tracks from snow should not be charged to this account, but to account No. 28, "Miscellaneous Structures."

CROSSINGS, CATTLE GUARDS, AND SIGNS.

104. To this account should be charged the cost of all labor and material used in constructing farm, country-road, or street crossings at grade, overhead bridges, cattle guards, and wing fences to same, and all track signs, crossing gates, and watchhouses at crossings, and transportation.

INTERLOCKING OR SIGNAL APPARATUS.

105. To this account should be charged the cost of interlocking or signal apparatus complete, when built by contract. If built by the railway company, the cost of labor and material, including all levers, racks, wires, pulleys, semaphores,

semaphore signals, ground signals, posts, materials in box troughs, and other fixtures, tower, foundation for same, and all other work necessary to complete it, and transportation.

TELEGRAPH LINES.

106. To this account should be charged the cost of newly constructed telegraph and telephone lines, including poles, wires, billets, insulators, instruments, and all other materials used, also labor employed in the construction work, cost of all tools used, and transportation.

STATION BUILDINGS AND FIXTURES.

107. To this account should be charged the cost of all material and labor expended on all station buildings, including cost of transportation, platforms, sidewalks, excavation, foundation, drainage, water, gas, and sewer pipes and connections, steam heating apparatus, stoves, electric light and power fixtures, including wiring for same, grading and putting ground in order after building has been finished; electric bells, elevators, and all other material, furniture, or fixtures used to complete the building; wells for water supply of stations; also salaries and expenses of Engineers and Architects.

NOTE—This account should include the cost of similar buildings on docks, wharves, and piers, when used for station purposes.

SHOPS, ROUNDHOUSES AND TURNTABLES.

108. To this account should be charged the cost of all buildings to be used as shops (including transfer tables), or roundhouses (including cinder

and drop pits), and turntables; plants for heating the buildings; platforms, sidewalks, and outhouses in connection therewith; oil houses, sand houses, storehouses for company's material, scrap bins, etc. This account should include amounts paid when erected by contract; labor and material when built by company, preparing grounds before and clearing up same after construction, foundations, painting, excavation for and lining of turntable pit, and of cinder or drop pits inside or outside of roundhouses; foundation for turntable, loading, unloading, and placing turntable in position, levers and stops for handling turntable; sewerage system, connection with water supply system, shop wells; architects' fees for drawing plans, supervision of construction by Engineering Department or others; transportation and all incidental expenses. This account does not include the cost of tracks laid in connection with these buildings.

SHOP MACHINERY AND TOOLS.

109. To this account should be charged the cost of all new machinery and additional tools placed in any of the shops or roundhouses, including foundation for same; transportation, loading, unloading, and placing machinery in position. It must not include any machinery or tools purchased to take the place of those that have been worn out or destroyed.

WATER STATIONS.

110. To this account should be charged the cost of material and labor expended in the construction of water stations for the purpose of supplying locomotives with water, including cost

of windmills, pumps, boilers, pumphouses, tanks, tubs, tank foundations, track tanks, or troughs, engines and all fixtures and pipes, standpipes or penstocks and connections; wells, dams, and reservoirs or cisterns; transportation; also engineering expenses, and tools used in the work. This account must not include waterworks, wells, etc., exclusively for supply of stations, hotels, tenements, or section houses, which should be charged to the appropriate account.

FUEL STATIONS.

111. To this account should be charged amounts paid under contract for, or the cost of all labor and material expended in, the construction of coal platforms, coal sheds, coal pocket chutes, woodsheds, and racks, and all machinery or appliances necessary to equip them for service. This account includes inclines at fuel stations (except the cost of track laid thereon), tipple cars, buckets, cranes for handling same, elevating machinery, gasoline or other engines for operating same, dumping machinery, all appliances for weighing coal in pockets and opening coal pockets, transportation, architects' fees, engineering, etc.

GRAIN ELEVATORS.

112. To this account should be charged the cost of ground on which elevator is located, cost of foundations, elevator building, conveyors, fixtures, machinery complete; and all material, labor, transportation, and other charges incidental to construction. This account does not include the cost of small storage elevators at way stations, which are considered to be station buildings.

STORAGE WAREHOUSES.

113. To this account should be charged the cost of ground on which storage warehouses are located, and cost of buildings, machinery, etc., complete, when built by contract; if built by the railway company, the cost of ground, material, machinery, fixtures, and labor, transportation, and all other expenditures incident to construction.

The buildings herein referred to are not the ordinary freight warehouses or stations where freight is received for shipment, etc., but warehouses in which merchandise is stored, and which the railway company or others operate as warehouses.

DOCKS AND WHARVES.

114. To this account should be charged the entire cost of docks, wharves, ferry or other landings, and inclines to transfer steamers, including grounds and riparian rights, dredging of slips, piling, filling cribs, pile protection, building cofferdams, pumping or bailing water, masonry walls or filling, etc., transportation, and all expenses incurred in the construction of these structures, except the cost of tracks and buildings thereon.

ELECTRIC LIGHT PLANTS.

115. To this account should be charged the cost of all labor and materials, including cost of transportation, used to put in operation either arc or incandescent light plants, such as dynamos, engines for running dynamos, wire constituting lines, glass globes, carbon or arc lights, carbonized filament for incandescent lights, poles, hangers for lights, insulators, and every expense in-

cidental to the erection of the plant. When it is necessary to erect a building for an electric light plant, the entire cost of the same, including ground, should be charged to this account.

ELECTRIC MOTIVE POWER PLANTS.

116. To this account should be charged the cost of ground on which electric-power stations are located, and the cost of erection of power and car sheds, including all expenditures for labor and material, stationary engines, boilers, and machinery, pumps, condensers, foundations, and settings for steam plants; generators, foundations, and settings, switchboard, and lighting apparatus for electric plants; current conductors, including poles, wires, and labor for overhead work, third rails, fastenings for same and labor laying same, with cost of inspecting, loading, and unloading; feed wires, track-bonding, and grade-crossing cut-outs; and all other expenditures connected with the installation of plants intended to generate and distribute electricity for motive power, including transportation.

GASMAKING PLANTS.

117. To this account should be charged the cost of all labor and material, including cost of transportation, used to put into operation a gasmaking plant complete. The cost of ground on which the plant is located should also be charged to this account.

MISCELLANEOUS STRUCTURES.

118. To this account should be charged the cost of structures of every character, including

cost of material, labor, transportation, and all incidental expenses connected therewith, which are permanent or a betterment to the property and enter into the cost of road, and which are not otherwise herein particularly referred to, and for which no account has been provided; the object being to designate one general classification, to which may be charged the cost of all minor superstructures, and in this way avoid increasing the number of general accounts.

LEGAL EXPENSES.

119. To this account should be charged the amount of all attorneys' salaries, fees, and expenses, and all other incidental legal expenses incurred during the process of construction of a road, except when the expense can be charged directly to the account for which it is incurred.

INTEREST AND DISCOUNT.

120. To this account should be charged discount on securities sold; interest on loans effected, and on notes issued for construction purposes or overdue payments to contractors or other creditors, and discount, interest, and exchange on other commercial paper issued for a similar purpose. Premium realized from sale of bonds, stock, or other securities should be credited to this account. Discount or premium realized from sale of bonds, stock, or other securities for a specific work should be applied to such work.

GENERAL EXPENSES.

121. To this account should be charged organization expenses, and expenses incurred in the

disposal of securities; salaries and expenses of general officers of a road under construction, clerks in general offices engaged on construction accounts or work, stationery, and office expenses; also all items of a special and incidental nature which can not be properly located under any other account.

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